

A satellite image showing a vast, mountainous landscape. The terrain is characterized by numerous ridges and valleys, with a complex network of rivers and streams. The rivers are light-colored, likely due to sediment, and flow through the valleys. The mountains are darker, showing some snow or ice cover. The overall color palette is dominated by earthy tones like brown, tan, and grey.

~2.5 km



~~Sediment
source~~

~~Palaeo-
geomorphology~~

=> No hypotheses



*Memory of system
only in sediments*

Sink toward Source

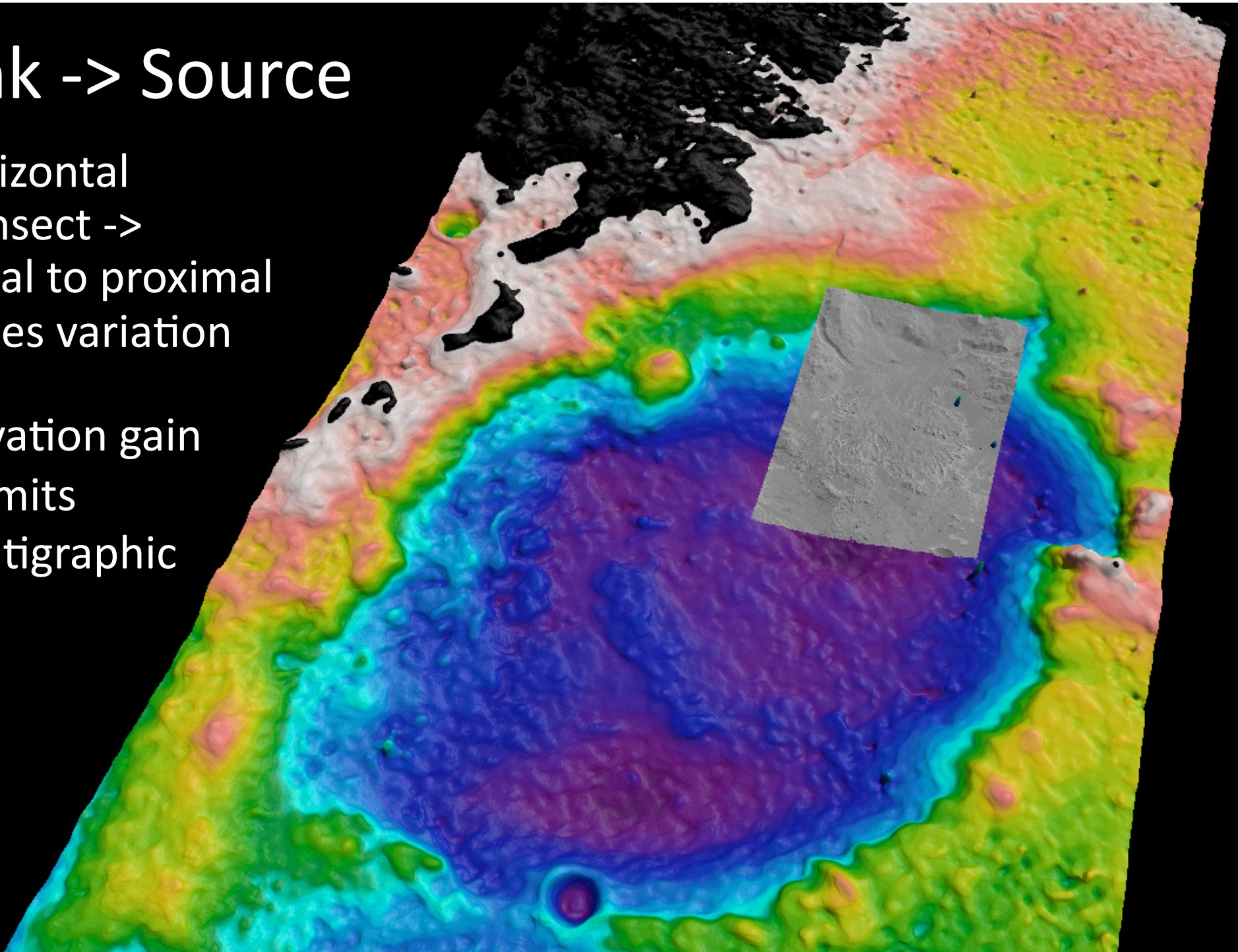
- Testable hypotheses
- Environmental diagnosis

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³Jan-Peter Muller

Sink -> Source

Horizontal
Transect ->
Distal to proximal
Facies variation

Elevation gain
Permits
Stratigraphic
rise



Known knowns

- Near complete source-to-sink sediment routing system
- Closed basin
- Well preserved paleogeomorphology
- Spatial and temporal grain-size segregation
 - Can sample variability in sedimentary rock types
- Distinct stratigraphic variability.

What can this tell us?

- We can directly link erosion to depositional record
 - We are not guessing the source region
- Sedimentary lithofacies can be linked to palaeogeomorphology
 - We do not have to guess where we are in the system

Eberswalde has a testable depositional model.

Hypothesis: Fluvio-deltaic system prograding into a lake

- Multiple sediment 'lobes' that progressively step basinward
- Large-scale channel switching (avulsion)
- Evidence for increased frequency of channel bifurcation at distal ends of lobes

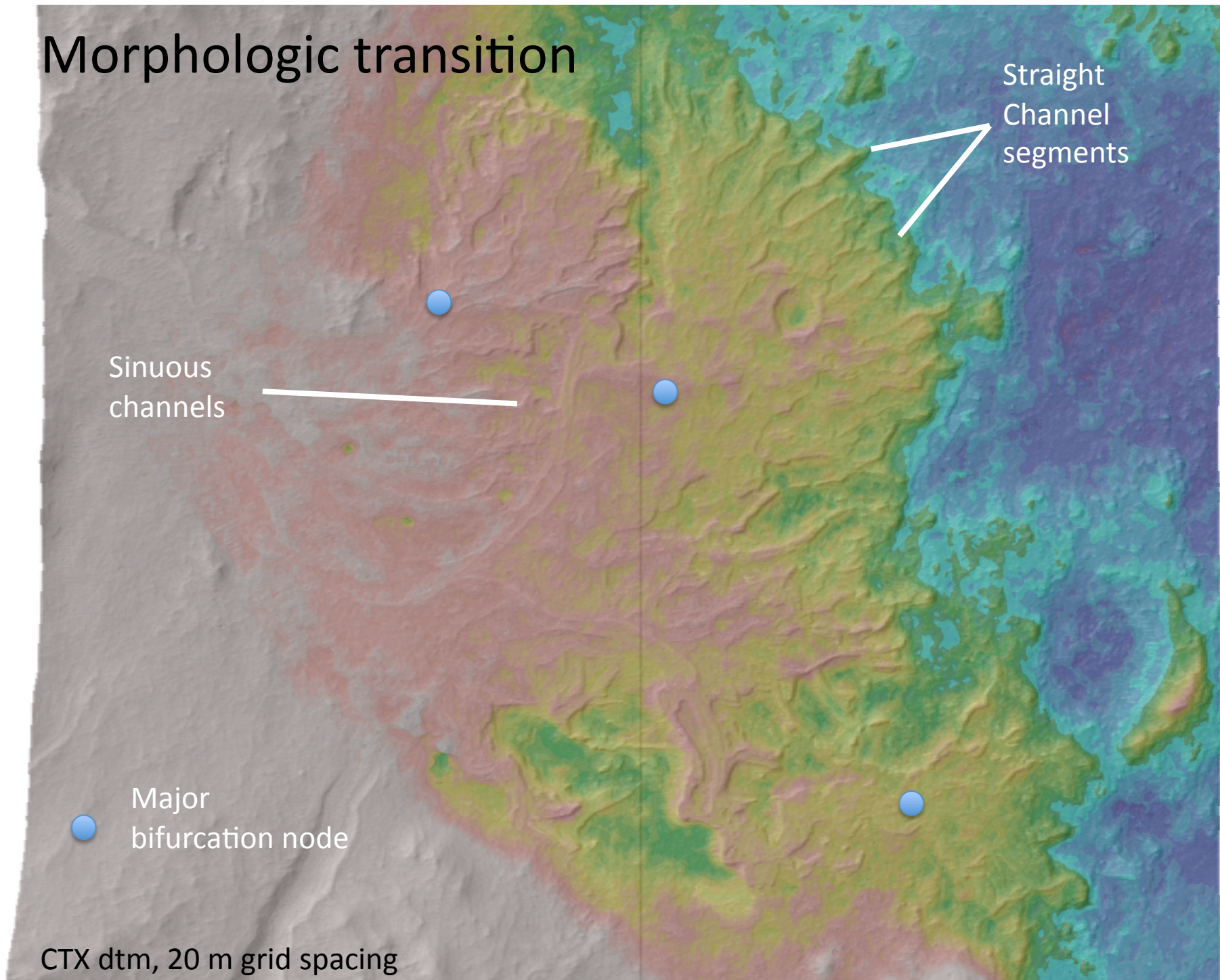
Morphologic transition

Straight
Channel
segments

Sinuuous
channels

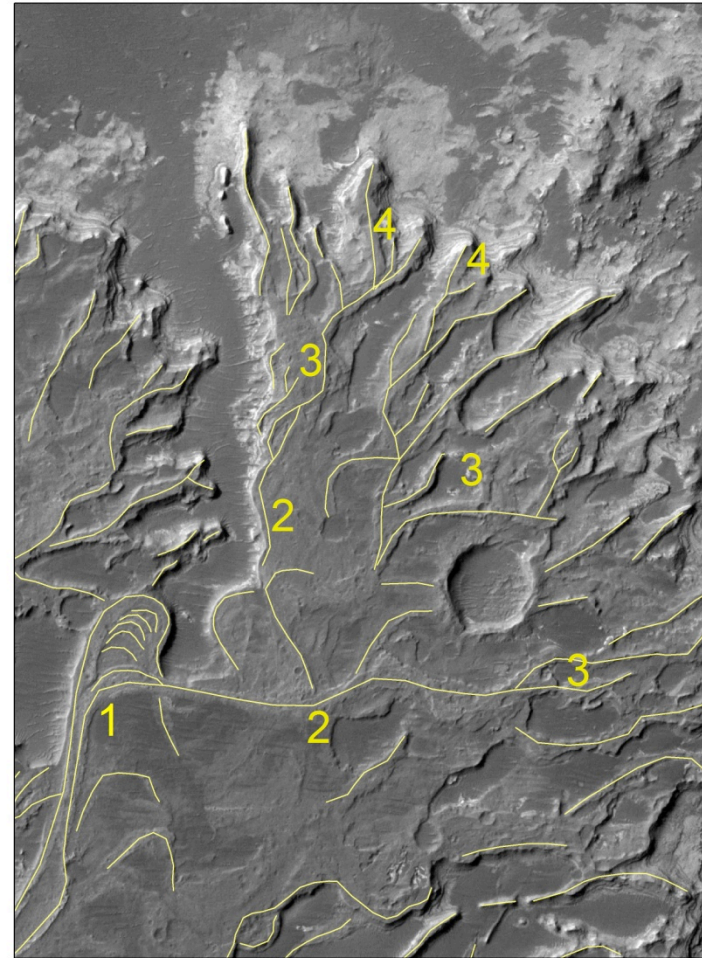
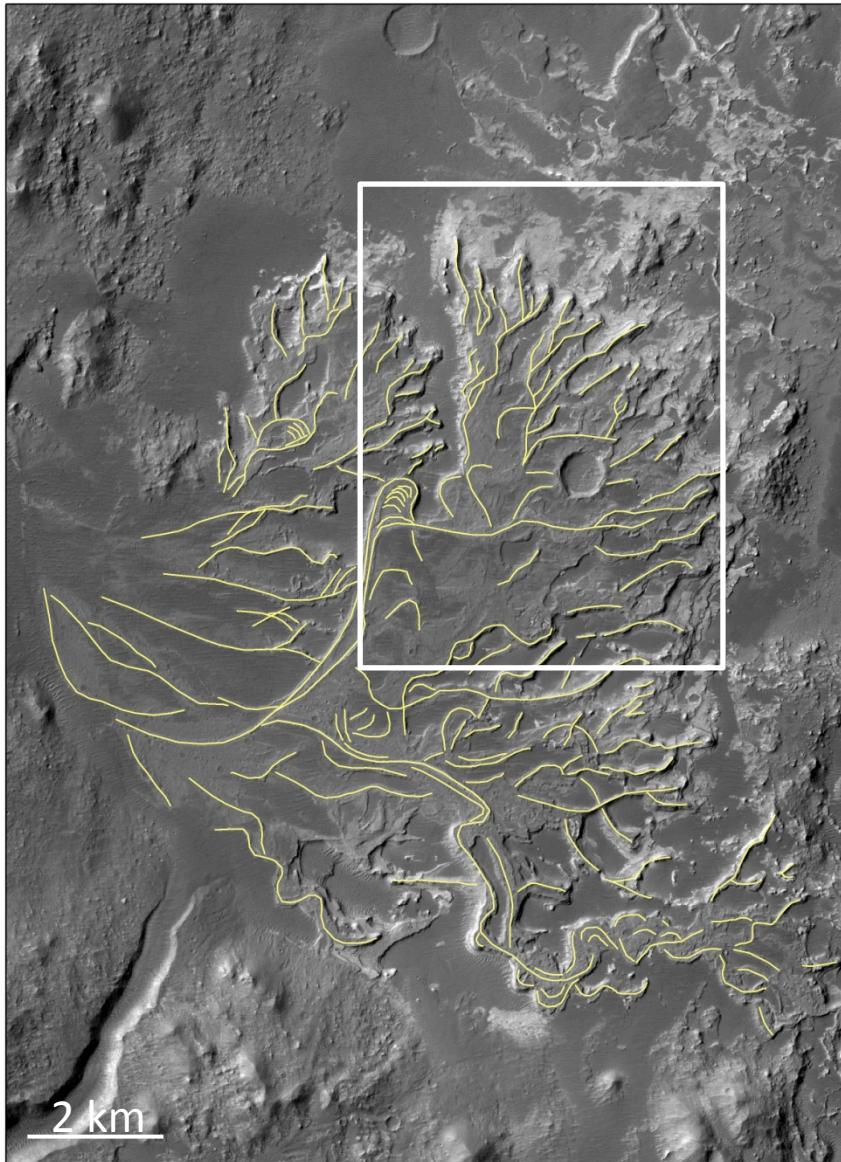
Major
bifurcation node

CTX dtm, 20 m grid spacing



Channel Bifurcation

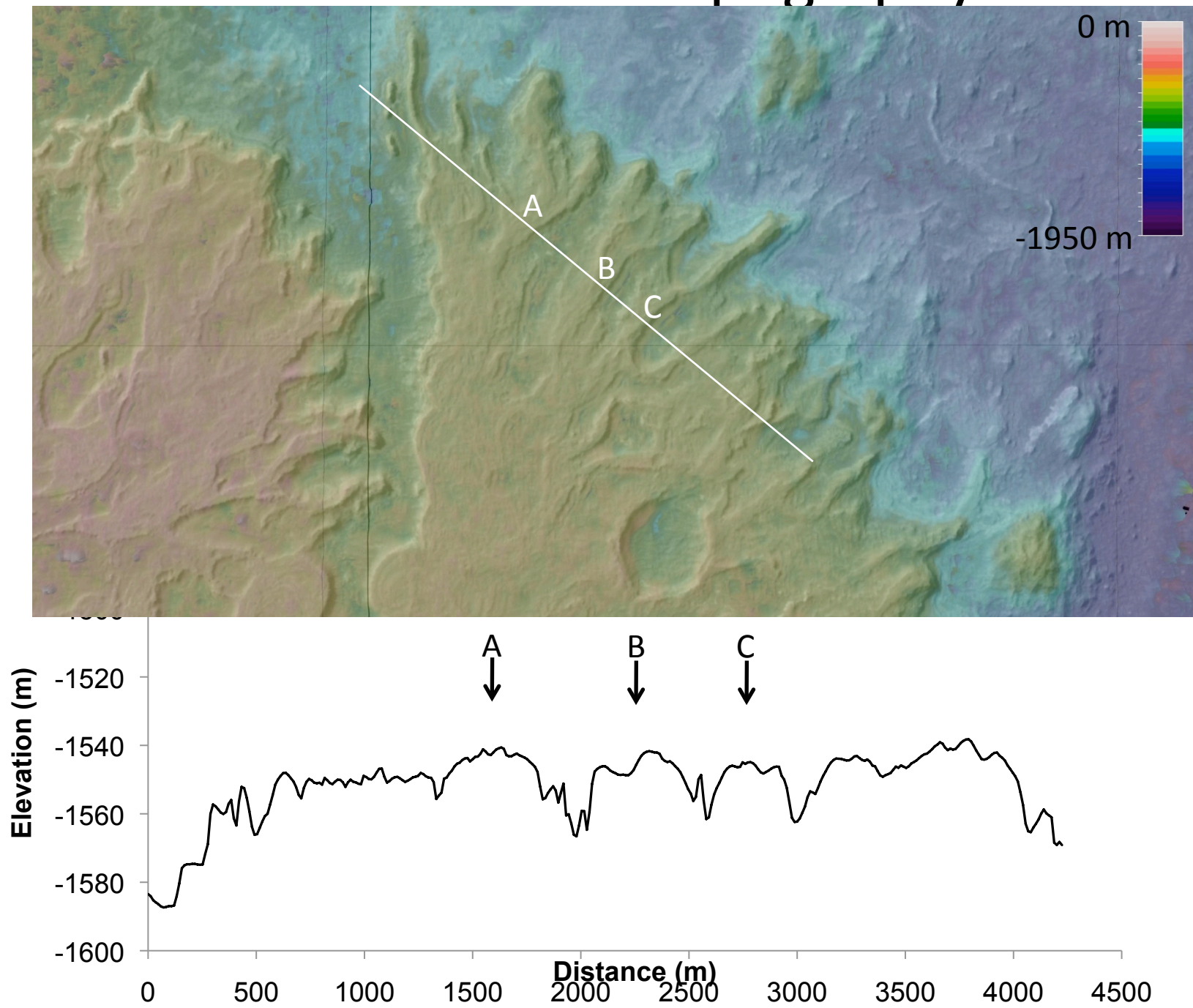
- Mouth bar development leads to channel bifurcation



Interpretation:

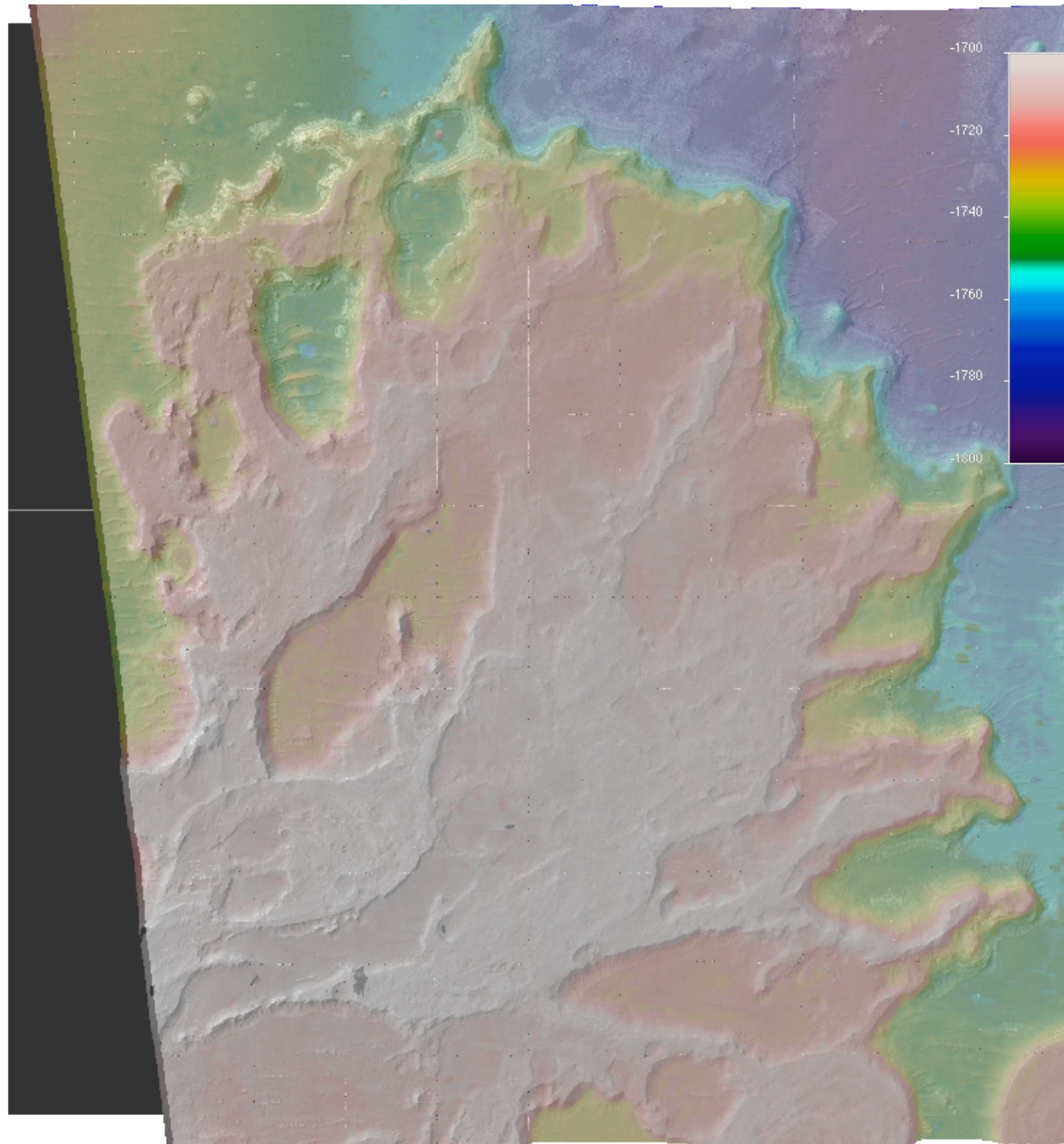
- multiple orders of bifurcation...or
- topographically overlapping sinuous channels

CTX Channel Topography



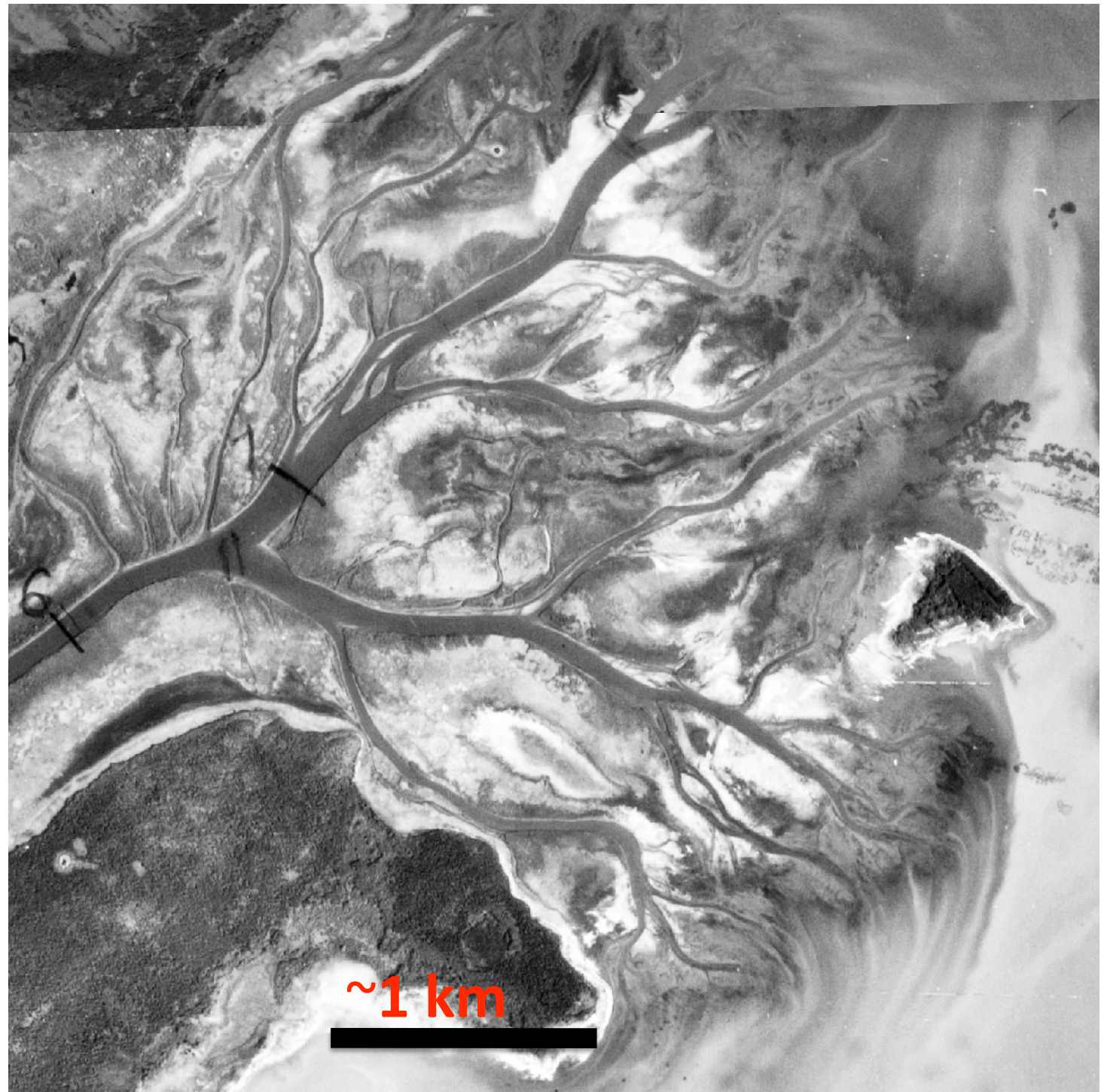
HiRISE Dtm

~1 km



Mossy delta, Canada

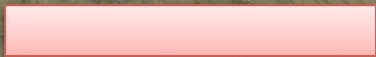
Edmonds &
Slingerland,
2007



Exhumed fluvial fan, Oman

Raised channels

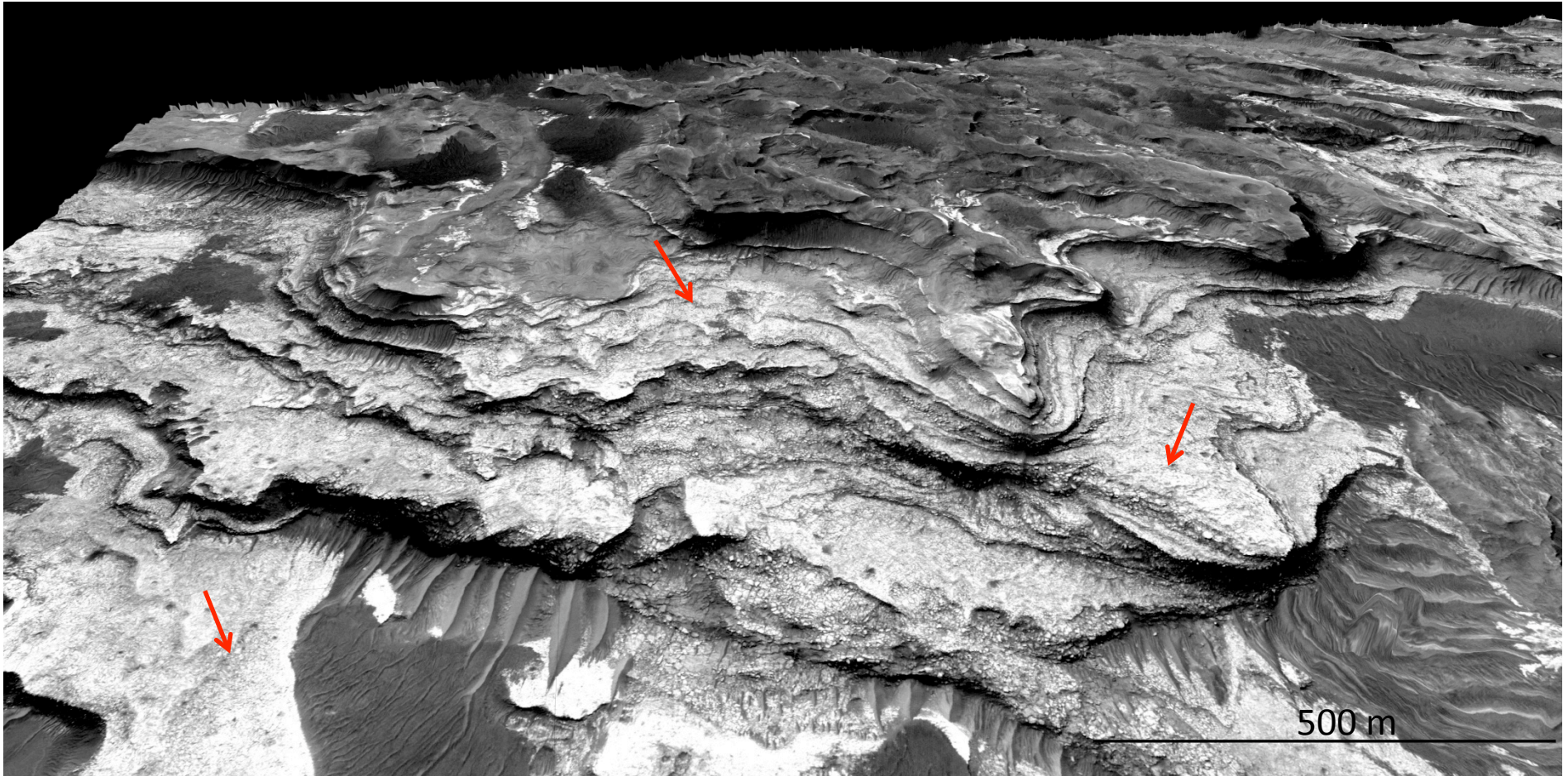
~10 km



Spaghetti channels – little bifurcation



Photomorphology predicts distinct stratigraphy

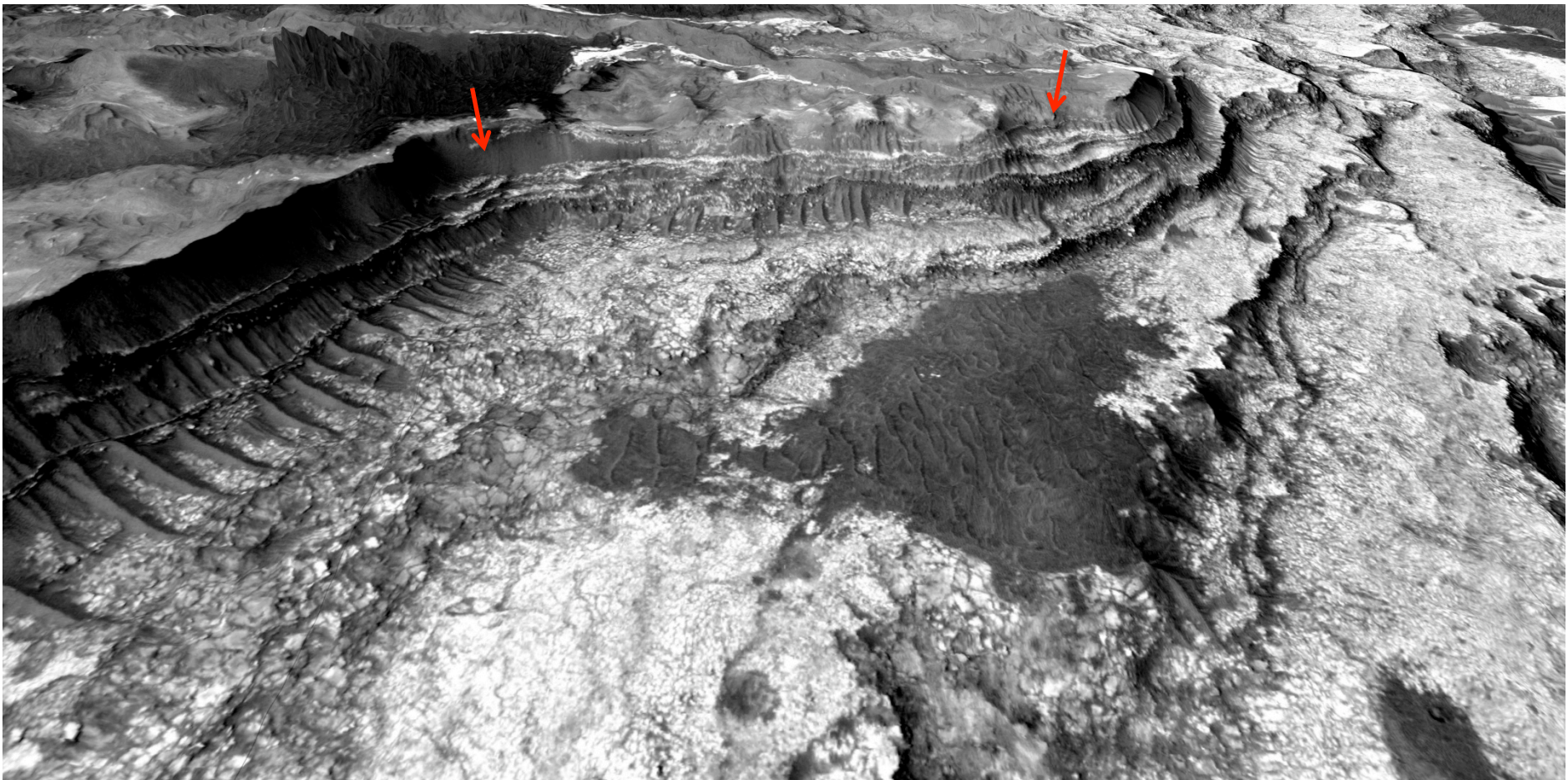


-Basal sequence:

- light-toned, polygonally fractured layered material
- lower 50 m of delta
- individual layering, m to sub-m scale thicknesses

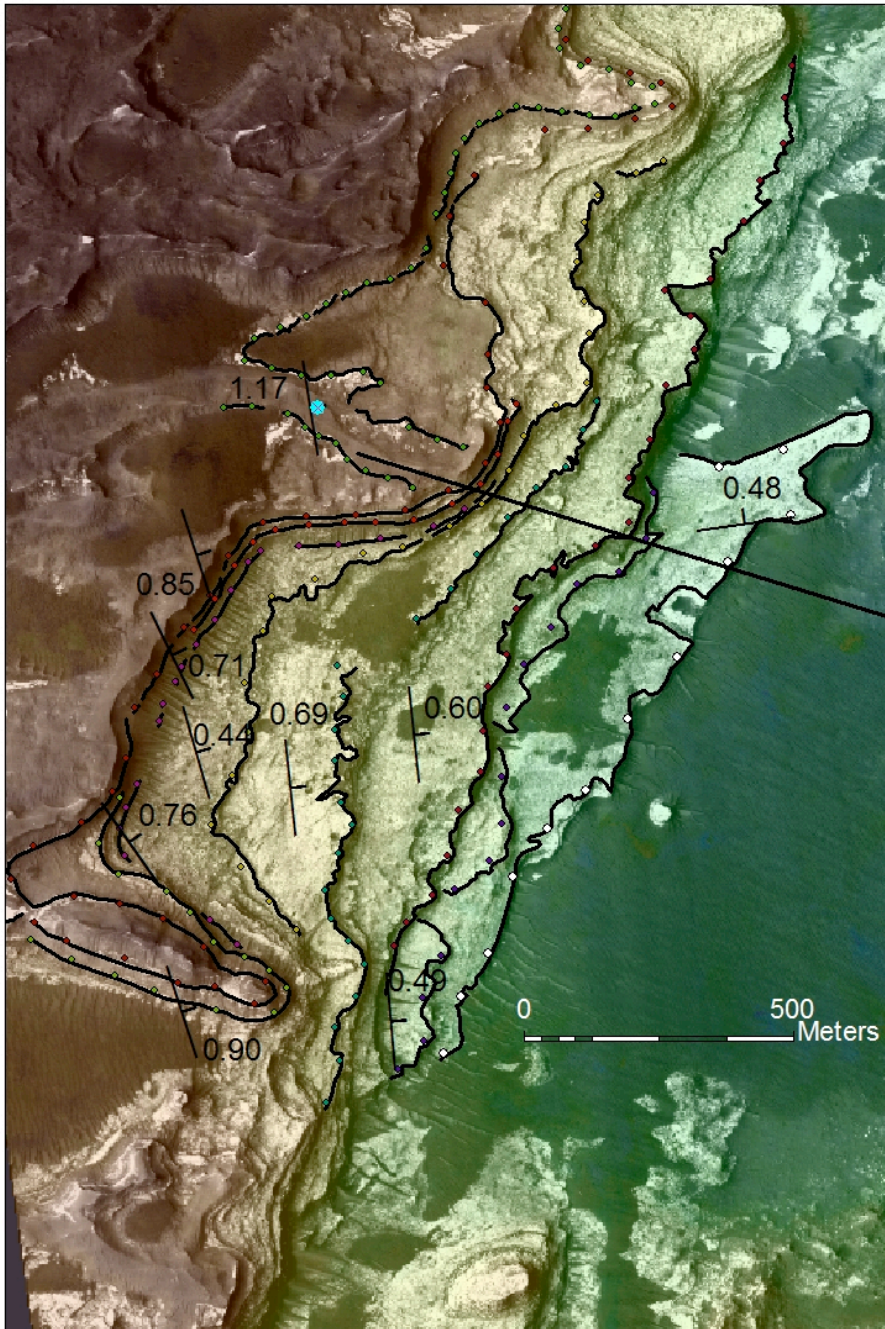
Upper Sequence

- Dunes obscure stratigraphy
- Bedding characteristics of light-toned beds similar to basal sequence
- Interpretations
 - Continuation of basal sequence, preferential aeolian cover on upper slopes
 - Intercalated coarse and fine sequences? (i.e. channel sands – distal channel muds-silts)
 - ?Change in source material, un-related to delta processes

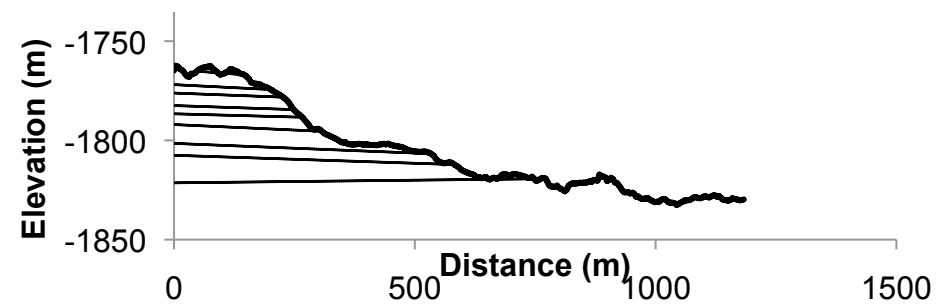


Distal Eberswalde

Consistent dip, $< 1^\circ$ towards crater interior



Layer ID	Dip	Dip_Dir	RMS Error
1	0.48	352	0.82
2	0.49	85	0.73
3	0.60	84	1.67
4	0.69	84	0.65
5	0.44	74	1.20
6	0.76	55	1.47
7	0.90	72	1.07
8	0.71	64	0.77
9	0.85	71	1.61
10	1.17	80	0.99

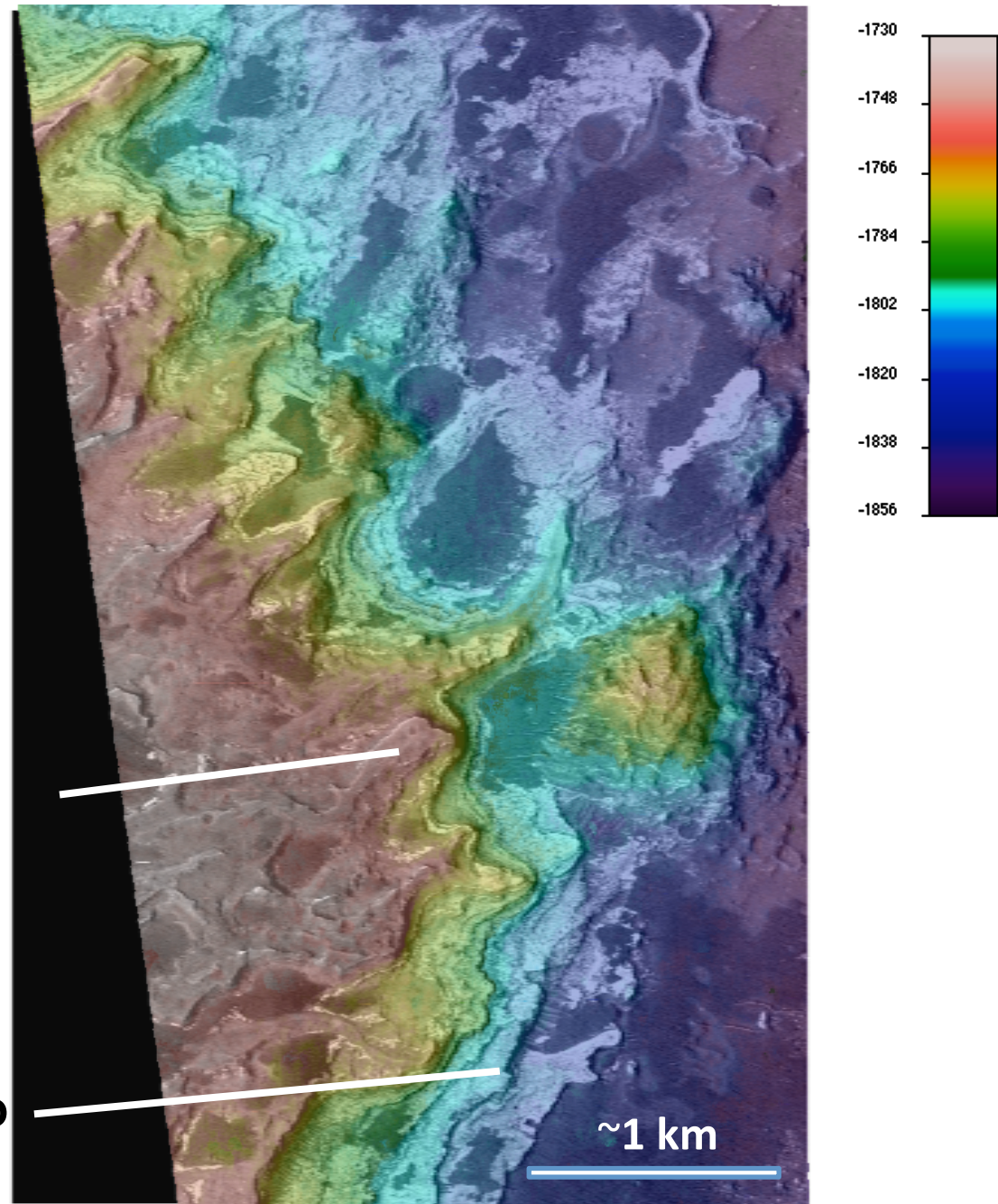


Distal Lobe 2: Photomorphology

We predict a vertical
coarsening-up
signature.

Fluvial channels

Delta front ->
Lacustrine deposits?

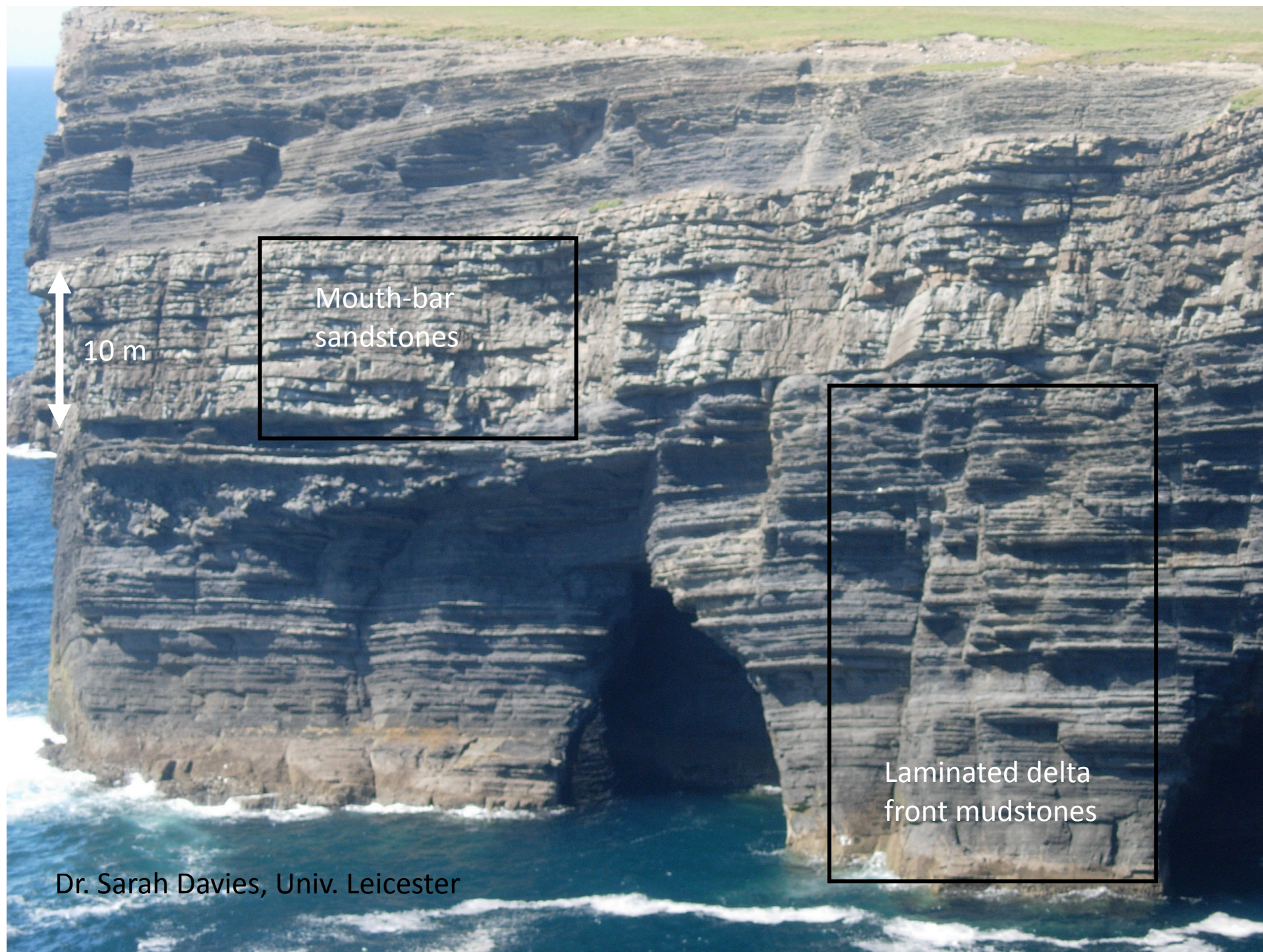


Facies prediction: delta progradation shows coarsening-up signature



Tullig Cycle, Clare, Ireland,
SJ Davies

Dr. Sarah Davies, Univ. Leicester



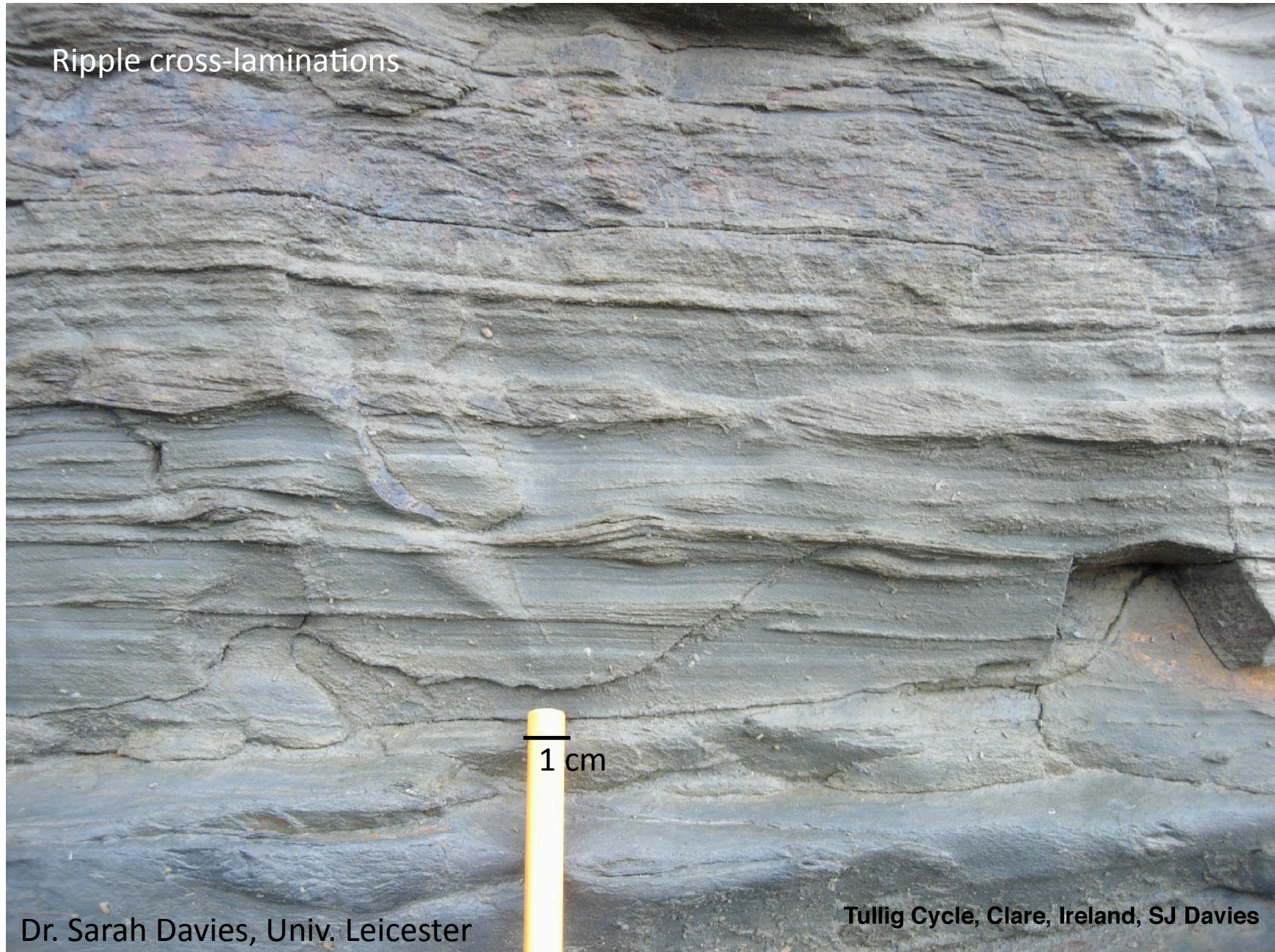
Mouth-bar
sandstones

10 m

Laminated delta
front mudstones

Dr. Sarah Davies, Univ. Leicester

Ripple cross-laminations



Dr. Sarah Davies, Univ. Leicester

Tullig Cycle, Clare, Ireland, SJ Davies

Climbing ripple cross-laminae

- Dominate delta front mouthbar deposits

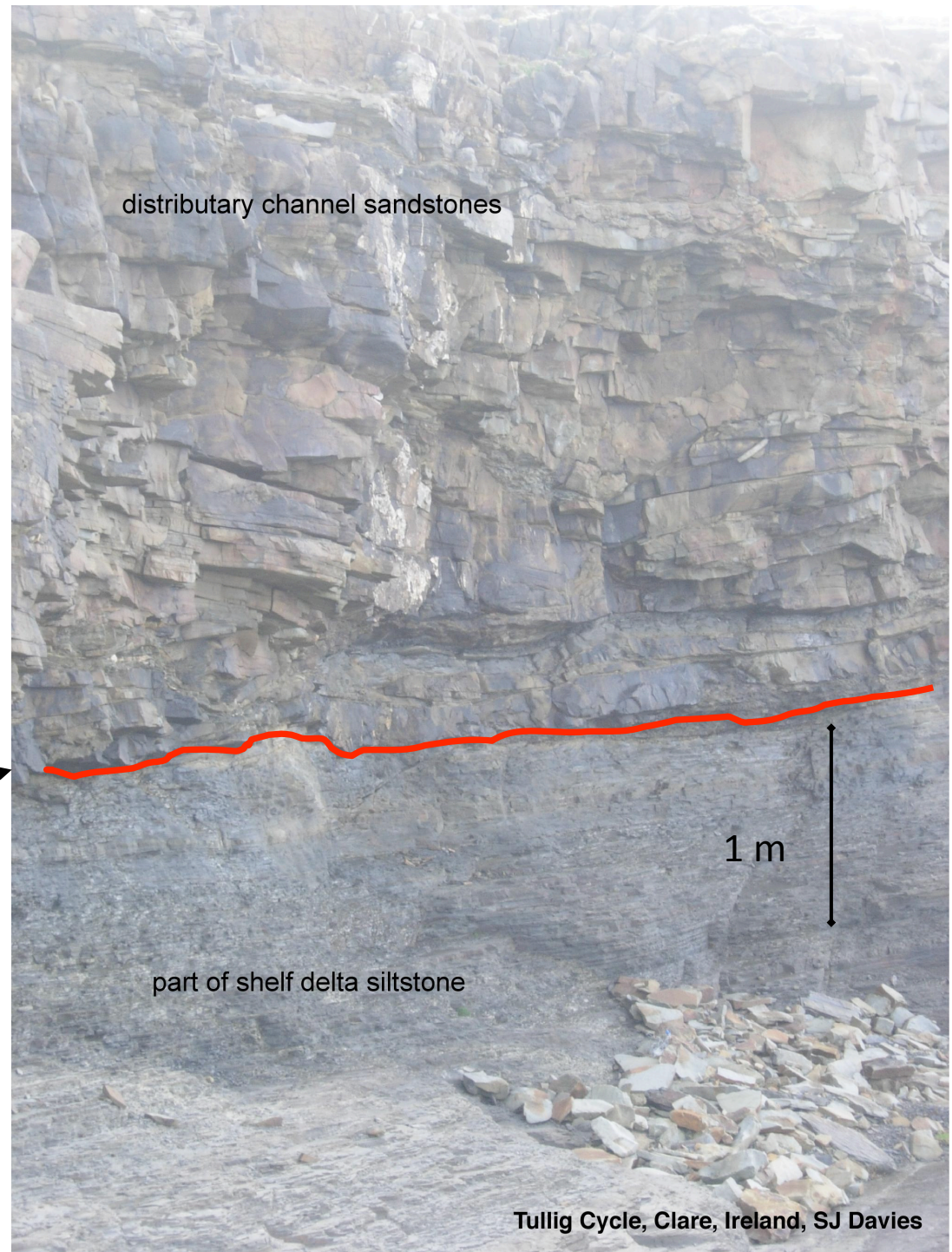


Rapid deceleration of jet flows in standing water
lead to high sediment aggradation rates

Fluvial distributary channel

Progradation of delta leads to migration of fluvial channel facies across the top of delta mouthbar facies

Distributary channel base: erosional relief of 10's cm

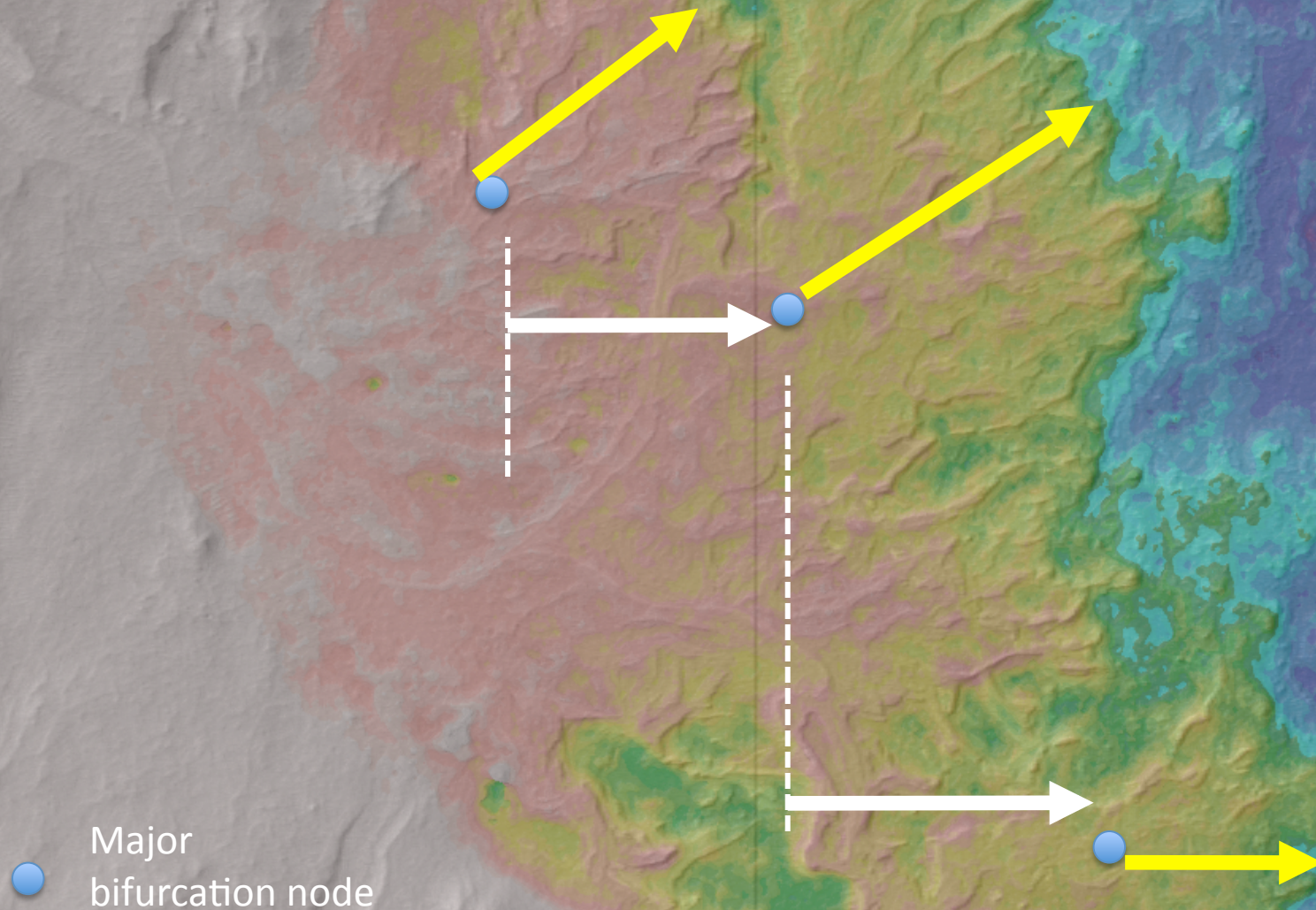


Cross-bedded sandstones in fluvial distributary channels



Tullig Sandstone

Horizontal translation leads to vertical
stratigraphic successions



CTX dtm, 20 m grid spacing

Delta-lake hypothesis questions

- Fluvial -> delta -> lake transition ?
- If lake, shallow lake, deep lake or transitions
- Multiple cycles of sedimentary activity
- Timescales of deposition – longevity of system

What could MSL tell us?

- Grain size and sedimentary structures
 - Sedimentary processes and proximity
- Sedimentary facies associations
 - High-resolution sedimentary environments
- Sedimentary geometries & architecture
 - Channel geometries -> palaeo-water discharge
- Provenance – we may tap interesting rocks from Eberswalde catchment

What could MSL tell us?

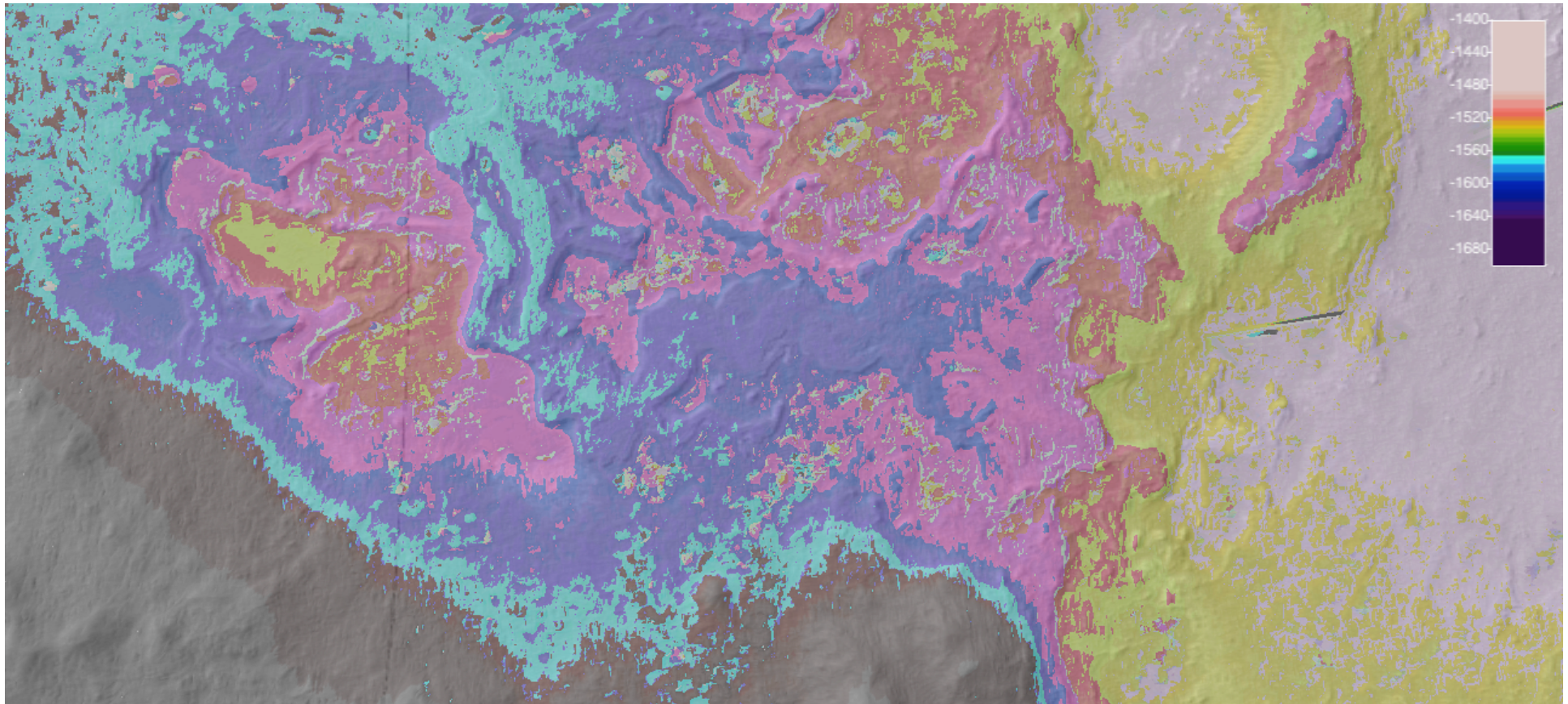
- Vertical sedimentary successions
 - Relative temporal evolution of sedimentary systems
 - Cycles of deposition and erosion
 - Stratigraphic hiatus' – time breaks
 - Large-scale stratigraphy leads to:
 - Relative chronology
 - Possible big time breaks
- > Can we say something about longevity of sedimentary system?

How can we reconstruct time?

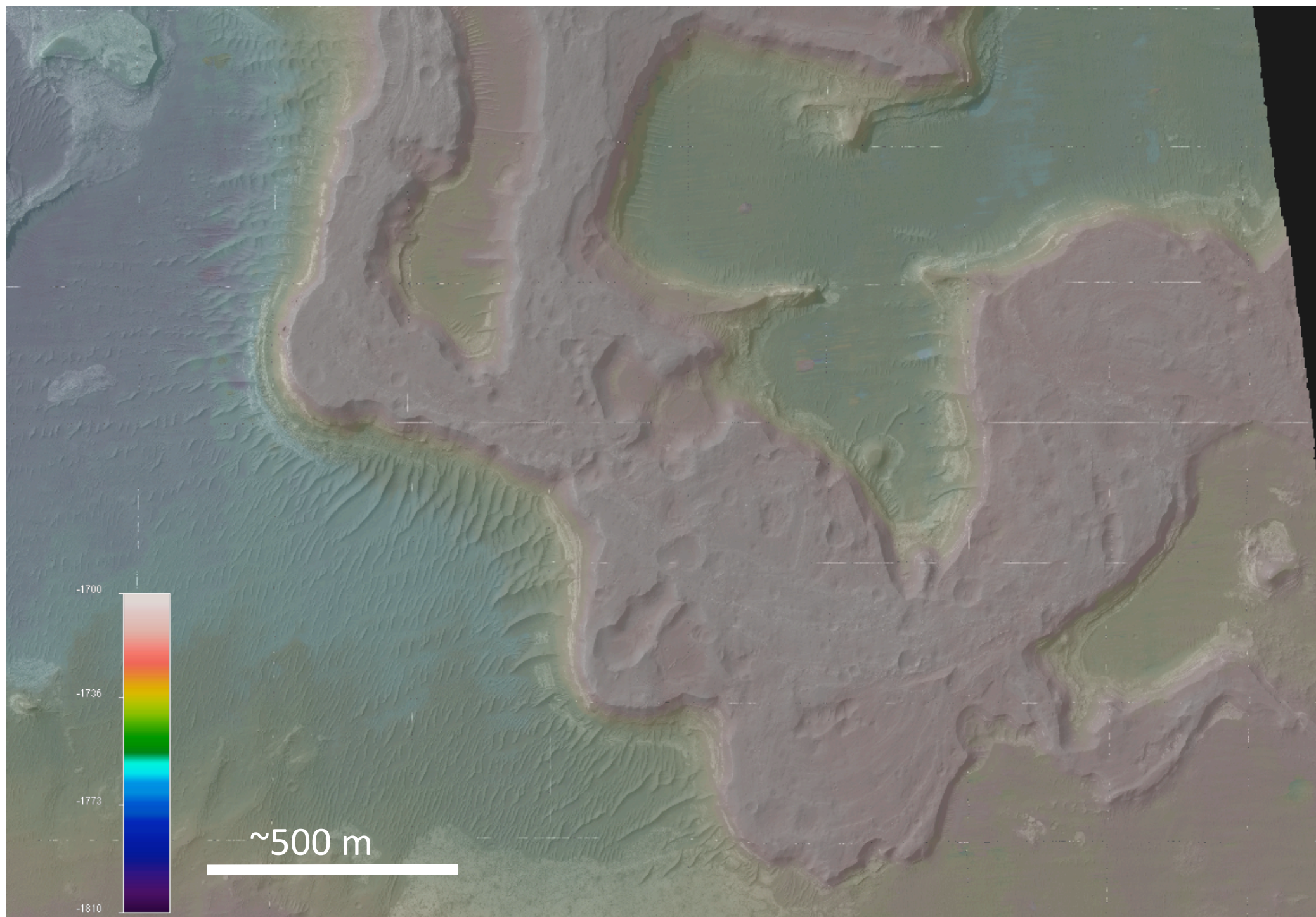
- For timescales look for time gaps
- Hiatuses
- Look for sedimentary facies disjunctions
- Duricrusts, aeolian intercalations,

Breaking Walther's Law

Hypothesis: Does lake level fall drive basinward shift of deltas?



Youngest meander belt extends basinward of older deltaic sediments
= basinward shift of depositional systems? Test through stratigraphy.



Pots of gold

- Source area evolution: provenance and weathering records
- Surface system evolution
- Water fluxes from fluvial systems
- Climate records – what supported lacustrine system
- Key site for habitability

Conclusions

- Eberswalde has rich diversity of depositional sedimentary features that can be linked to palaeo-geomorphology.
- Sedimentary structures and architecture from MSL will provide stage for robust interpretations of process and environment.
- We can couple mineralogy to geologic context.
- We can understand issues of habitability because we know the context.